REMARKS

Claims 15-26 and 28-34 are all the claims pending in the application. Claim 27 is canceled, above, as being redundant. Claims 15-26 and 28-34 stand rejected under 35 U.S.C. 112, second paragraph, and on prior art grounds. Applicants respectfully traverse these rejections based on the following discussion.

I. The 35 U.S.C. §112, Second Paragraph, Rejection

Claims 15-26 and 28-34 stand rejected under 35 U.S.C. §112, second paragraph, as being indefinite for failing to point out and distinctly claim the subject matter which applicants regard as the invention. In claims 15, 21, and 29, the phrase "a thickness of said upper most layer reduces sensitivity to resistivity shifts associated with said silicide surface" is rejected as being unclear because the thickness is not defined by the claim. The claims have been amended to define that the uppermost layer (or "top level of metallurgy" in claims 21 and 29) has an increased thickness with respect to the other layers of metallurgy within the device. Applicants respectfully submit that this claim language defines the relative thickness of one layer with respect to other layers within the structure and, therefore, properly defines a structural feature of the device. In addition, claim 27 has been cancelled, above, as now being redundant.

In addition, claims 21 and 29 stand rejected based on insufficient antecedent basis for the limitation "said uppermost layer." Claims 21 and 29 have been amended to change the objected phrase to "top level of metallurgy" (which has antecedent basis). Applicants respectfully submit that the forgoing claim changes are not made to overcome prior art rejections, but instead are made merely to clarify the claim language. With the forgoing amendments, it is Applicants intention to define the same invention and not to increase or decrease the breadth of the invention being defined. Therefore, it is Applicants intention that the foregoing claim amendments do not narrow the invention being defined. Instead, it is Applicants intention that the exact same

breadth of invention be defined, using different wording. In view of the foregoing, the Examiner is respectfully requested to reconsider and withdraw this rejection.

II. The Prior Art Rejections

Claims 15-18, 21-24, and 28-32 stand rejected under 35 U.S.C. §103(a) as being unpatentable over Ngo et al., hereinafter "Ngo" (U.S. Patent No. 6,303,505); claims 19-20, 25-26 and 33-34 stand rejected under 35 U.S.C. §103(a) as being unpatentable over Ngo in view of Ohashi et al., hereinafter "Ohashi" (U.S. Patent No. 6,184,143); claims 15-18, 21-24, and 28-32 stand rejected under 35 U.S.C. §103(a) as being unpatentable over Filipiak et al., hereinafter "Filipiak" (U.S. Patent No. 5,447,887); and claims 19-20, 25-26, and 33-34 stand rejected under 35 U.S.C. §103(a) as being unpatentable over Filipiak in view of Dass et al. (U.S. Patent 6,046,101) hereinafter "Dass." Applicants respectfully traverse these rejections based on the following discussion.

A. The Rejection Based on Ngo

The Office Action argues that Ngo discloses that the copper silicide layer could comprise 10%-20% of the thickness of the top level of the metallurgy. However, Ngo is silent regarding the percentage that the copper silicide represents of the overall copper interconnect 13A. Indeed, the Office Action admits that Ngo does not expressly teach that copper silicide layer comprises 10%-20% of the thickness of the top level of metallurgy. Instead, the Office Action proposes that since Ngo discloses that the silicide layer can be 1000 A thick and that the application states that the silicide layer can be 1000 A thick that Ngo, therefore, discloses that the copper silicide layer in Ngo must be 10%-20% of the thickness of the top level of metallurgy. Applicants respectfully disagree with this conclusion, especially considering that Ngo does not disclose the thickness of the top level of metallurgy 13A. Since the thickness of the top level of metallurgy

13A is not disclosed, the percentage that the silicide layer represents cannot be calculated. In other words, Ngo clearly does not disclose any information that would allow one to know the percentage that the silicide layer represents of the entire thickness of the top level of metallurgy.

Further, there is nothing Ngo that would lead one ordinarily skilled in the art to break away from the well-known teaching that silicide layers should comprise less than 10% of the copper silicide metallurgy in order to avoid resistivity problems (see the applied Filipiak reference, discussed below, and page 2, lines 5-15 of the application). This clear teaching regarding the necessity to restrict the silicide to less than 10% of the overall thickness of the metallurgy adds additional evidence as to why the conclusion reached in the Office Action is incorrect.

In view of the forgoing, Applicants submit that Ngo does not teach that the "increase in thickness of said top level of metallurgy with respect to thicknesses of other metallurgy layers within said device reduces sensitivity to resistivity shifts associated with said silicided surface" as defined by independent claim 21 and similarly defined by independent claims 15 and 29. To the contrary, Ngo does not even discuss that the top level of metallurgy would be thicker than other metallurgy layers within the device, much less that the thickness of the top level of metallurgy is controlled so that the sensitivity to resistivity shifts is reduced. Therefore, Applicants respectfully submit that independent claims 15, 21, and 29 are patentable over Ngo. Further, dependent claims 16-18, 22-24, 27, and 30-32 are similarly patentable, not only by virtue of their dependency from a patentable independent claim, but also by virtue of the additional features of the invention they define. In view of the forgoing, the Examiner is respectfully requested to reconsider and withdraw this rejection.

B. The Rejection Based on Ngo in view of Ohashi

As shown above, Ngo is deficient in teaching the features defined by independent claims 15, 21, and 29. The Office Action combines Ngo with Ohashi in an argument that dependent

claims 19-20, 25-26, and 33-34 are unpatentable. More specifically, the Office Action refers to Ohashi for teaching an opening allowing direct electrical contact with a solder terminal. Applicants respectfully disagree that one ordinarily skilled in the art would have combined Ngo with Ohashi because there is no suggestion in either reference (or any other prior art of record) for this combination. Instead, the only motivation for such a combination lies in Applicants disclosure.

Notwithstanding the foregoing, even if one ordinarily skilled in the art had made the combination of references proposed in the Office Action, the combination would not teach or suggest the invention as defined by independent claims 15, 21, and 29 principally because no prior art of record teaches or suggests that the thickness of the top level of metallurgy reduces the sensitivity to resistivity shifts, or that the silicide can exceed 10% of the thickness of the metallurgy, as the claimed invention does. Therefore, Applicants respectfully submit that independent claims 15, 21, and 29 are patentable over the proposed combination of references. Further, dependent claims 19-20, 25-26, and 33-34 are also patentable, not only because of the additional features that they define, but also because they depend from a patentable independent claim. In view the forgoing, the Examiner is respectfully requested to reconsider and withdraw this rejection.

C. The Rejection Based on Filipiak

The disclosure in Filipiak is consistent with the description of the problems associated with the prior art (see page 2, lines 5-15 of the application). More specifically, the prior art teaches that the thickness of a silicide layer should not exceed 10% of the total thickness of the metal layer. Filipiak is consistent with this teaching where it states that the thickness of the silicide layer 32 should not be greater than 10% of the total thickness of the copper interconnects as shown in Figure 5 (column 5, line 62-66). Filipiak explicitly explains that the reason for limiting the thickness of the silicide layer to less than 10% of the total copper thickness is that the

silicidation degrades the resistivity of the copper interconnect (column 5, line 66-column 6, line 1). Filipiak states that where resistivity is not an important issue silicide thickness may not be as tightly controlled.

In the claimed invention, the thickness of the uppermost layer reduces sensitivity to resistivity shifts associated with the silicided surface. Therefore, in the claimed invention, resistivity is an important issue in that reducing sensitivity to resistivity shifts is a claimed feature. With respect to the claimed invention (e.g., where resistivity is an important issue), the teachings in Filipiak require that the silicide layer not be greater than 10% of the total thickness of the interconnect.

Contrary to the teachings in Filipiak, independent claims 21 and 29 define that the silicide surface is within the top 10-20% of the conductive layer. Therefore, since the claims define that resistivity is an important issue and that the silicide surface is outside the range required by Filipiak, Filipiak cannot be said to teach or suggest the invention.

With respect to the arguments in the Office Action that one ordinarily skilled in the art would have experimented outside the 10% range in order to arrive at Applicants' invention, Applicants note that Filipiak teaches one ordinarily skilled in the art not use a silicide thickness greater than 10%. Therefore, using the teachings in Filipiak, one ordinarily skilled in the art would not use a silicide layer of having a thickness greater than 10% where resistivity shifts are important (as in the claimed invention). The claimed invention breaks away from conventional teachings and includes a silicide layer in the range of 10-20%. Filipiak teaches away from the claimed invention by teaching that the silicide layer should not be greater than 10% in situations where resistivity is important. Therefore, the arguments in the Office Action that Applicants merely discovered an optimum working range involving only routine skill are inappropriate considering that the prior art (Filipiak) teaches one ordinarily skilled in the art not to use ranges above 10% when resistivity issues are important.

Therefore, with respect to claims 21 and 29, that define a silicided surface in the upper 10% to 20% of the bonding pad, Applicants submit that such features are clearly not taught or

suggested by Filipiak. Indeed, Filipiak teaches away from such claimed features. In addition, with respect to independent claim 15, Applicants submit that Filipiak does not teach or suggest that the thickness of the uppermost layer reduces resistivity shifts associated with the silicide portion. Applicants resolved resistivity issues according to the thickness of the uppermost layer. To the contrary, Filipiak teaches that one should limit the thickness of the silicide portion in order to control resistivity issues. Therefore, it is also Applicants position that Filipiak teaches away from the claimed invention define by independent claim 15.

Thus, as shown above, Filipiak teaches away from the invention defined by independent claims 15, 21, and 29. Therefore, the invention defined by independent claims 15, 21, and 29 is patentable over Filipiak. Further, dependent claims 16-18, 23-24, 28, and 30-32 are similarly patentable over Filipiak, not only by virtue of their dependency from a patentable independent claim, but also by virtue of the additional features of the invention they define. In view the forgoing, the Examiner is respectfully requested to reconsider and withdraw this rejection.

D. The Rejection Based on Filipiak in view of Dass

The Dass reference is only utilized in the Office Action to show the use of tin solder when connecting to a bonding pad. Dass is silent regarding siliciding the upper layer of the bonding pad. Therefore, Dass does not cure the deficiencies of Filipiak as discussed above. Thus, even if one ordinarily skilled in the art had combined Dass and Filipiak, the proposed combination would not teach or suggest the invention as defined by independent claims 15, 21, and 29, as discussed above. Therefore, these independent claims are patentable over the proposed combination of references. Further, dependent claims 19-20, 25-26, and 33-34 are similarly patentable, not only by virtue of their dependency from a patentable independent claim, but also by virtue of the additional features of the invention they define. In view of the foregoing, Applicants respectfully request that the Examiner reconsider and withdraw this rejection.

BU9-98-110DIV
09/666,325

III. Formal Matters and Conclusion

In view of the foregoing, Applicants submit that claims 15-26 and 28-34, all the claims presently pending in the application, are patentably distinct from the prior art of record and are in condition for allowance. The Examiner is respectfully requested to pass the above application to issue at the earliest possible time.

Should the Examiner find the application to be other than in condition for allowance, the Examiner is requested to contact the undersigned at the local telephone number listed below to discuss any other changes deemed necessary.

Please charge any deficiencies in fees and credit any overpayments to Attorney's Deposit Account Number 09-0456.

Respectfully submitted,

Dated: 1/16/03

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BU9-98-110DIV
09/666,325

Attachment

Marked up Version of Changes Made

15. (Amended) A semiconductor device having at least two levels of interconnecting metallurgy, said semiconductor device comprising:

a first level of substantially silicide free metallurgy; and

an uppermost layer of metallurgy including a bonding pad, wherein a top of said uppermost layer comprises a silicided surface,

wherein [a] an increase in thickness of said uppermost layer with respect to the thickness of said first level of substantially free metallurgy reduces sensitivity to resistivity shifts associated with said silicided surface.

21. (Amended) A semiconductor device comprising:

an exterior surface having a top level of metallurgy,

wherein an exposed portion of said top level of metallurgy comprises a bonding pad,

wherein an upper 10% to 20% of said bonding pad comprises a silicided surface, and

wherein [a] an increase in thickness of said [uppermost layer] top level of metallurgy with respect to thicknesses of other metallurgy layers within said device reduces sensitivity to resistivity shifts associated with said silicided surface.

Please cancel claim 27 without prejudice or disclaimer

29. (Amended) A semiconductor chip comprising:

an exterior surface having a top level of metallurgy; and

an interior having at least one internal level of metallurgy,

wherein said top level of metallurgy [is thicker] has an increased thickness than said internal level of metallurgy,

wherein an exposed portion of said top level of metallurgy comprises a bonding pad,

wherein an upper 10% to 20% of said bonding pad comprises a silicided surface, and

wherein [a] said increased thickness of said [uppermost layer] top level of metallurgy reduces sensitivity to resistivity shifts associated with said silicided surface.